



FINAL REPORT

**Serious Incident of SriLankan Airlines
Flight UL190, Airbus Industries A321-251, bearing registration
4R-AND from VGHS to VCBI diverted to VOMM
on 02nd Dec 2020**

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**List of Abbreviations**

ADD	-	Accepted Deferred Defect
ADIRU	-	Air Data Inertial Reference Unit
ADM	-	Air Data Module
ADR	-	Air Data Reference, part of ADIRU function
AFS	-	Auto Flight System
ALT/NAV	-	Altitude Navigational Mode
AP	-	Auto Pilot
ATPL	-	Airline Transport Pilot Licence
A/THR	-	Auto Thrust
CAASL	-	Civil Aviation Authority of Sri Lanka
CAS	-	Calibrated Airspeed
CFDS	-	Centralized Fault Display System
CPT/Capt.	-	Captain
DFDR	-	Digital Flight Data Recorder
DGCA	-	Director General of Civil Aviation
ECAM	-	Electronic Centralized Aircraft Monitoring
EFCS	-	Electronic Flight Control System
ELAC	-	Elevator and Aileron Computer
FAC	-	Flight Augmentation Computer
FCOM	-	Flight Crew Operating Manual
FC	-	Flight Cycle
F/CTL	-	Flight Control
FCOM	-	Flight Crew Operating Manual
FDA	-	Flight Data Analysis
FDM	-	Flight Data Monitoring
FD	-	Flight Director
FG	-	Flight Guidance, function part of FMGC
FMGC/S	-	Flight Management Guidance Computer/System
F/O	-	First Officer
FH	-	Flight Hours
FOM	-	Flight Operation Manual
Ft	-	Feet
GS	-	Ground Speed
hrs.	-	hours
IAS	-	Indicated Air Speed
Kts	-	Knots
LEAP	-	Leading Edge Aircraft Propulsion
MCC	-	Maintenance Control Centre
MET	-	Meteorological / meteorology
MMEL	-	Master Minimum Equipment List (Manufacture published)
MEL	-	Minimum Equipment List (Operator Published, based on MMEL)
MOR	-	Mandatory Occurrence Report
MSN	-	Manufacturer Serial Number
PF	-	Pilot Flying
PHC	-	Pitot Heat Computer
PIC	-	Pilot in Command
P/N	-	Part Number
PFD	-	Primary Flight Display
PFR	-	Post Flight Report
PM	-	Pilot Monitoring



QAR	-	Quick Access Recorder
RVSM	-	Reduced Vertical Separation Minimum
SAT	-	Static Air Temperature
SLA	-	SriLankan Airlines
SSM	-	Sign/Status Matrix
SOP	-	Standard Operating Procedures
TAT	-	Total Air Temperature
UTC	-	Coordinated Universal Time
VCBI	-	Bandaranaike International Airport, Katunayake, Sri Lanka to
VGHS	-	Hazrat Shahjalal International Airport, Dhaka, Bangladesh
VOMM	-	Chennai International Airport, India



Serious Incident of SriLankan Airlines Flight UL 190, Airbus A321-251, 4R-AND at FL 360, from VGHS to VCBI diverted to VOMM on 2nd Dec 2020.

1. Introduction

The incident was notified to the Civil Aviation Authority of Sri Lanka by Flight Safety Department of SriLankan Airlines through a Mandatory Occurrence Report (MOR). On receiving the MOR, based on the nature of the description of multiple failures of the said flight, it was decided to categorize the occurrence as a serious incident.

Accordingly, an Aircraft Accident Investigation Board (AAIB) comprise of two members from airworthiness and flight operations were appointed by the Authority as per the provisions laid down in Section 56 of the Civil Aviation Act no 14 of 2010.

Pursuant to Regulation 8 of Aircraft Accident and Incident Investigation Regulations of Sri Lanka and Paragraph 4.8 of the ICAO Annex 13, Aircraft Accident and Incident Investigation, the AAIB notified the serious incident to the International Civil Aviation Organization and Bureau d'Enquêtes et d'Analyses (BEA- France), being the State of Manufacturer and the State of Design. Furthermore, in terms of Chapter 4, Paragraph 4.10 of Annex 13 and Regulation 23(1) of the Aircraft Accident and Incident Investigation Regulations of Sri Lanka, France as the State of Manufacture and the State of Design was invited to appoint an Accredited Representative to assist the investigation. Thereby, BEA – France, appointed a BEA Investigator as an accredited representative and two technical advisors from Airbus and EASA to assist the accredited representative.

Furthermore, AAIB requested assistance for DFDR analysis from Transport Safety Investigation Bureau (TSIB), Singapore which is an independent aircraft accident investigation organization of Singapore based on the Arrangement between CAASL and TSIB-Singapore. Accordingly, TSIB – Singapore appointed an Accredited Representative for this investigation.

1.1 Synopsis

On 02nd December 2020, SriLankan Airlines, Flight UL 190 was scheduled to depart from Hazrat Shahjalal International Airport (VGHS), Dhaka, Bangladesh to Bandaranaike International Airport (VCBI), Katunayake, Sri Lanka. There were 77 passengers and 8 crew, including two tech crew on board the flight.

Two hours into the flight, during cruise, at FL 360, the aircraft had experienced NAV ADR disagree and Flight Alternate Law reversion. The ECAM actions were carried out by the flight crew. They had contacted Indian ATC to inform of their inability to maintain RVSM and to obtain weather information in Colombo and Chennai. Due to heavy rain in Colombo and the multiple failure status of the aircraft, the Pilot in Command decided to divert to Chennai International Airport (VOMM), India.

1.2 Objective

The objective of this investigation is to prevent recurrence of similar incidents in future and not to apportion blame or liability.

2. Factual Information

Operator : SriLankan Airlines Ltd
Airline Centre
Bandaranaike International Airport
Katunayake



Sri Lanka

Registered Owner : AerCap Global Aviation Trust
Ireland

Aircraft Make and Model : Airbus, A321-251 (MSN 07697)

Aircraft Nationality : Sri Lanka (4R)

Aircraft Registration : 4R-AND

Place of Incident : at Flight level 360, in Indian air space

Date and Time : 02nd Dec 2020
0740 (UTC); 1310hrs (Local time)

Local time zone : + 0530hrs

2.1 History of Flight

On the out bound flight UL 189, from Bandaranaike International Airport (VCBI) to Hazrat Shahjalal International Airport (VGHS) on 1st of December 2020, the aircraft had experienced erroneous CAS3 during the takeoff roll, with a rejection of the ADR3 by the Electronic Flight Control System (EFCS) and the Auto Flight System (AFS). Further the aircraft had experienced a failure of the F/O Pitot probe heater, in approach phase into VGHS.

Thereafter, the aircraft was dispatched for the return flight UL 190, under two MEL items of F/CTL Maintenance status, due to ADR3 rejection by the Flight Control System and F/O PITOT heater.

On 2nd December 2020, the flight, UL190 took off from Hazrat Shahjalal International Airport (VGHS), Dhaka, Bangladesh to Bandaranaike International Airport (VCBI), Katunayake, Sri Lanka. During flight the CAS3 was erroneous from the takeoff roll, as in the previous flight. The aircraft experienced cloudy weather during cruise. In addition, CAS2 became erroneous, due to F/O Pitot blockage since its heater was inoperative. As the ADR2 was not switched off, ADR2 continued to provide EFCS and AFS with erroneous CAS.

EFCS first detected the discrepancy of two CAS values, leading to the reversion to alternate law. Shortly after that, the AFS rejected the ADRs, leading to the loss of AP/FD/ATHR functions. At this stage the PIC took control of the aircraft and the ECAM actions were carried out by the F/O. After analyzing the weather conditions at VCBI and Chennai International Airport (VOMM) India, the aircraft diverted to VOMM.

2.2 Injuries to Persons: Nil

2.3 Damage to Aircraft: Nil

**2.4 Other Damages:** Nil**2.5 Personnel Information:****2.5.1 Flight Crew - Pilot-In-Command**

Licence : Valid ATPL (ATPL/A/806) issued by the DGCA Sri Lanka; valid till 11th Feb 2022

Aircraft Ratings : PIC-A320

Flying Experience : Total: 5127:39 hrs.
PIC A320: 71:02 (including line training)
Total A320: 1050:21hrs.
Total A330: 4077:18 hrs.

2.5.2 Flight Crew - First Officer

Licence : Valid CPL (CPL/A/937) issued by the DGCA Sri Lanka; valid till 05th Oct 2021

Aircraft Ratings : A320 & A330.

Flying Experience : Total: 1579 hrs.

2.6 Aircraft Information

Type and Model : Airbus A321-251N

Manufacturer's Serial No. : 07697

Certificate of Registration : No 315, Registered in Sri Lanka Civil Aircraft Register

Certificate of Airworthiness : No. 265 Valid till 26th October 2021

Total Airframe Hours : 10307 FH/ 3522 FC

Engines : 02, LEAP -1A32 engines

2.7 Meteorological Information:

01st December 2020, UL 189 - the METAR at VCBI at 23:10 UTC, the visibility was 10 km or more, there were broken clouds at 2500 feet above aerodrome level. Temperature was +25°C and dew point was +23°C.

02nd December 2020, UL 190 - the METAR at VGHS, at 06:00 UTC, the visibility was 3.2 km, few cloud coverage at 1500 feet above aerodrome level and scattered at 10,000 feet above aerodrome level. Temperature was +25°C and dew point was +17°C.

2.8 Aids to Navigation: Not applicable

2.9 Communication: As per the interview, the flight crew had communicated with the Indian ATC and Colombo MCC (Maintenance Control Centre) during the time of the incident.

2.10 Aerodrome Information: Not applicable



2.11 Flight Recorders: The details of the DFDR are as follows;

Part Number: 2100-4245-00

Serial Number: 001069490

Manufacture: L3 Aviation Recorders

Mod status: HW MOD 09, 10, 11, 12, 13

The raw data of the Digital Flight Data Recorder was shared with TSIB – Singapore and BEA-France for data analysis.

2.12 Medical and Pathological Information: Not applicable

2.13 Fire: Not applicable

2.14 Survival Aspect: Not applicable

2.15 Test and Research: Not applicable

2.16 Organizational and Management Information:

2.16.1 The Operator, SriLankan Airlines Ltd

2.16.1.1 SriLankan Airlines Flight Operation Department is responsible for safe and efficient operation of flights in compliance with applicable regulations. The Department maintains qualified technical crew and ground staff to carry out the duties and responsibilities of Flight Operations.

2.16.1.2 Aircraft in SriLankan Airlines fleet are maintained by SriLankan Airlines Ltd in accordance with the scope of the approval granted in its MOE (Maintenance Organization Exposition) by CAASL. Engineering and Maintenance Division of SriLankan Airlines Ltd is a holder of EASA (European Aviation Safety Agency) Part 145 maintenance organization approval.

2.16.2 The Regulator, Civil Aviation Authority of Sri Lanka.

2.16.2.1 CAASL is responsible for the registration and issuance of certificate of airworthiness to aircraft, licensing of personnel, and certification of air operators, and continued post certification surveillance. It is also responsible for the certification and surveillance of aeronautical service providers.

2.17 Additional Information: Nil.

2.18 Useful or Effective Investigation Techniques: Nil



3. Analysis

3.1 FDR data

The following analysis was based on the DFDR report obtained from the BEA, France, and is reproduced below in its entirety.

On 01st Dec 2020, at 23:37:55 UTC, 4R-AND,UL 189 was on take-off roll at VCBI, runway 04 with Ground speed (GS) recorded at 57kts, increasing, CAS from ADC3 becoming valid.

CAS 3 was around 40kts below CAS1 and CAS2 (CAS1- Capt. = 69kts / CAS2- FO = 68kts / CAS3-FO = 30kts). ADC rotary switch was in normal configuration, meaning Captain PFD was supplied by ADC1 and F/O PFD was supplied by ADC2.

As per PFR report, at 23:37 UTC during takeoff roll, “ADR3” from EFCS1 was recorded as above 80kts, due to the discrepancy between CAS3 and CAS1-Capt. / CAS2-FO, reflecting the ADR3 rejection by ELAC/SEC at that time.

AFS was identified as Identifiers in the PFR, to indicate that FMGC computer also detected the CAS3 discrepancy.

At 23:37:59 UTC, ground speed was 77kts, CAS3 was crossing 60kts. CAS3- Capt. and CAS3 -FO remained recorded around 25kts below CAS1 and CAS2 (CAS1-Capt = 87kts / CAS2-FO = 86kts / CAS3FO = 64kts).

At 23:38:17 UTC, aircraft took-off with recorded values of CAS1-Capt. = CAS2 -FO = 157kts, CAS3 -Capt. = 144kts and CAS3 -FO = 146kts. A discrepancy of around 100ft (and up to 120ft during the flight) was recorded between ALT1-Capt. /ALT2 -FO and ALT3 –Capt./ALT3-FO/ISISALT.

During the flight, CAS1-Capt.was consistent with CAS2-FO. CAS3 (CAS3-Capt. /CAS3-FO) was around 6kts lower than CAS1-Capt. / CAS2- F/O during the flight.

Aircraft performed the climb, cruise and descent phases with no additional information reported at the PFR with no master warning and master caution triggered.

At 02:14:28 UTC, the flight UL 189, was in approach phase toward VGHS crossing 1100ft RA (5000ft QNH). CAS1-Capt. & CAS2 -FO remained at 6kts above CAS3 –Capt. & CAS3 -FO. ECAM alert “ANTI ICE F/O PITOT” and Failure message “PITOT PROBE” from ADR2 were recorded in the PFR. ADC rotary switch was set to "FO on 3". Capt and F/O ADC configuration remained the same till the end of the flight.

As per the Abnormal and Emergency Procedures of the Company FCOM, ANTI ICE F/O PITOT requires to set the ADC rotary switch on to “F/O on 3”. The failure message recorded in the PFR indicates that at that time the PITOT PROBE encountered an issue with the probe heating system.

After landing at VGHS, during the rollout below 80kts and until the 2nd engine shut-down, “ADIRU 1/2/3 Disagree” from AFS was recorded in the PFR. During this phase, CAS3 –Capt. /CAS3 -FO reached up to 30kts less than CAS1 –Capt. /CAS2 -FO.

“ADIRU 1/2/3 Disagree” is triggered by the FMGC when it rejects any ADRs because of CAS discrepancy.

On 2nd December 2020, at 05:39:34 UTC during engine start for the return flight UL190 from VGHS to VCBI, the Master lever from ENG2 was switched ON. Captain was in normal configuration on ADC1 and ADC rotary switch was still on "FO on 3".



ADR3 from EFCS1 and ANTI ICE F/O PITOT maintained from flight UL189. The aircraft was under MEL due to F/O Pitot fault and F/CTL Maintenance message triggered during the previous flight UL189. As per PFR, “ADR3” from EFCS1 is recorded from the beginning of the PFR as it was present from the previous flight. As per design, this message remains present on ground, and after engines shutdown, in the EFCS computers as long as the aircraft is electrically supplied. “F/CTL” message at 05:44 UTC, in the Maintenance status associated to ADR3 message. It alerts the crew at the end of the flight that maintenance action is required on F/CTL message.

At 05:41:21 UTC, Master lever from ENG1 was switched ON.

At 05:44:00 UTC, aircraft was taxied -out and ground speed (GS) started to increase. F/O was Pilot Flying at that time.

At 05:54:34 UTC, aircraft was on the take-off roll with GS indicating 30kts. CAS became valid as follows: CAS1 (Capt) was recorded valid at 33kts (displayed on Capt PFD), CAS2 (FO) was recorded valid at 31kts and CAS3 (FO) (displayed on FO PFD) were invalid, meaning its value was still below 30kts.

At 05:54:39 UTC, GS was recorded at 56kts, CAS1 –Capt. was 61kt and CAS2 -FO was 60kts. CAS3-FO remained invalid.

At 05:54:41 UTC, GS was 69kts. CAS3-FO became valid and was recorded around 35kts below CAS1 and CAS2 as follows: CAS1-Capt was recorded valid at 72kts (Capt PFD), CAS2- FO was recorded valid at 71kts and CAS3 (FO) was recorded at 38kts (F/O PFD).

As per PFR, “ADIRU1/2/3 DISAGREE” was reported at 05:54 UTC.

a) ADR3 rejection by AFS during takeoff roll

This failure message was triggered by FMGC because of CAS3 discrepancy.

As FAC compared the CAS with a lower threshold, CAS3 was also rejected by FAC at that time.

Systems status at that time were as follows;

- Pitot 2 heating issue. No impact on CAS2 at that time.
- ADR 1 and ADR 2 valid for EFCS and AFS
- ADR 3 was invalid and rejected by EFCS and AFS.
- F/CTL in Normal law and AP/FD/ATHR were available.

At 05:54:44 UTC, CAS1 –Capt. was recorded at 86kts, CAS3 -FO was recorded at 62kts.

At 05:54:47 UTC, GS was 95kts, CAS1 -CPT (on CPT PFD) was crossing 100kts. At the same time, CAS3 (FO) (on F/O PFD) was recorded at 81kts. At that time Capt. was the PM and F/O was the PF.

b) Callout at 100 kts

QRH normal procedure at Take-off requires that the PM calls out “100kts” and that the PF announces “Check”. This callout should enable the detection of airspeed discrepancy during the takeoff roll.

At 05:54:53 UTC, GS was 123kts, CAS1 –Capt. (on Capt. PFD) was recorded at 120kts. CAS3 (FO) (on F/O PFD) reached 100kt.



At 05:55:06 UTC, aircraft took-off with the following CAS values recorded: CAS1Capt. = 165kts. CAS2FO = 164kts and CAS3FO = 151kts.

c) ADR rejection memorization in AFS computer

If the CAS discrepancy remains present after lift-off, then FACs computers memorize the ADR rejection for the rest of the flight, even if the discrepancy disappears. This memorization can be cancelled by an OFF then ON sequence on the FAC pushbutton on the overhead panel. FMGCs computers memorize the ADR rejection only as long as AP is engaged. When AP is disengaged, if the discrepancy disappeared, then the ADR is considered valid again by the FMGC.

At 06:17:56 UTC, aircraft was climbing through 35,200ft with AP1/FDs in NAV mode. ADC rotary switch was briefly set to "NORM" for 9 second, then back on "FO on 3". CAS were recorded as followed:

- CAS1-Capt and CAS2FO were 264kts;
- CAS3FO were 257kts.

In cruise, up to 07:30:00 UTC, CAS1 Capt. and CAS2 (FO) were consistent with each other. CAS3FO was around 6kts of difference lower than CAS1 (Capt.)/CAS2 (FO).

From that time, CAS2 (FO) started to diverge from CAS1 Capt. by around 3kts below CAS1 (Capt); CAS1Capt > CAS2FO >CAS3FO.

At 07:36:05 UTC, CAS1 -Capt. was recorded at 257kts, CAS2 (FO) was recorded at 255kts, CAS3 (FO) were recorded both around 251kt. From that time on wards CAS2FO started to decrease.

From 07:36:25 UTC, CAS2 (FO) went below CAS3 (FO). From that time on wards CAS1 (Capt.) > CAS3 (Capt.)/CAS3 (FO) > CAS2 (FO).

At 07:40:19 UTC, aircraft was in cruise at FL360. AP1/FDs were in ALT/NAV mode. CAS, TAT and SAT were recorded as followed:

CAS1 (Capt.) was 259kt (on Capt. PFD)

CAS2 (FO) was 247kt, decreasing to 243kt

CAS3 (FO) was 253kt (displayed on F/O PFD); TAT(Capt.) = TAT(FO) = -16°C and SAT = -44°C. F/CTL reverted to alternate law and the master caution was triggered.

d) Multiple ADR rejection by EFCS

From the time when the master cautions triggered, CAS2 seemed to be affected by the weather conditions, combined with the lack of Pitot heating. As per Significant Weather Chart (SIGWX), there were some isolated embedded cumulonimbus between FL480 and FL250. The Ops Procedure of the MEL associated to the item F/O PHC requires to switch off the ADR2 if icing conditions are encountered.

ECAM warnings F/CTL ALTN LAW and NAV ADR DISAGREE were the consequences of CAS1 and CAS2 discrepancy by more than 16 kts, whereas the ADR3 had already been rejected.

All AFS functions (AP, FD, ATHR, characteristic speeds, Rudder Travel Limit) were normal at that time (no ECAM warning), because AFS monitoring is based on a two by two comparison between the CAS as long as they have a valid SSM (Sign/Status Matrix). $|CAS1-CAS2| > FAC$ threshold but $|CAS1-CAS3| < FAC$ threshold and $|CAS2-CAS3| < FAC$ threshold. Therefore, both CAS1 and CAS2 were still considered as consistent by the AFS.



Systems status - Pitot 2 heating issue impacted CAS2. ADR 1 and ADR 2 were rejected by EFCS. ADR 3 rejected by EFCS and AFS (FAC only). F/CTL Alternate law and AP/FD/ATHR were normal.

At 07:43:33 UTC, aircraft was in cruise at FL360. AP1/FDs were in ALT/NAV mode. ADC rotary switch was set on "NORM" for 2min 10 second.

At that time, CAS1- Capt was 257kts (on Capt. PFD), CAS2-FO was 248kts (on F/O PFD) and CAS3-FO was 252kt. At 07:44:03 UTC, AP1/FD lateral mode changed to heading (HDG) and the aircraft initiated a left turn.

e) Diversion

The PIC had initiated the diversion at that time. At 07:48:35 UTC, aircraft was at FL360. AP, FD and A/THR were lost. FAC1 & FAC2 rejected all ADR sources (FAC1F = FAC2F = 1).

At that time, CAS1 (Capt.) was 259kts (on Capt. PFD), CAS2 (FO) was 242kts and CAS3 (FO) was 253kts (on F/O PFD).

f) Multiple rejection by AFS

CAS2 was different from CAS1 and from CAS3 and was thus rejected by FAC. When two CAS are rejected by comparison, the third one is automatically rejected by FAC. Therefore, both FACs rejected all the ADR, leading to the loss of both FDs. The AP, associated with the ECAM warning "AUTO FLT AP OFF". The A/THR, associated with the ECAM warning "AUTO FLT A/THR OFF".

g) The characteristic speeds.

The failure message FAC1/DMC2 was issued by the DMC because of invalid characteristic speeds received from the FAC. The Rudder Travel Limit function in both FACs, associated with the ECAM warnings AUTO FLT RUD TRV LIM2 and AUTO FLT RUD TRV SYS (loss in FAC2, immediately followed by loss in FAC1), ROW/ROP function, associated with the ECAM warning SURV ROW/ROP LOST.

Systems status - Pitot 2 heating issue. ADR 1 rejected by EFCS and FAC. ADR 2 rejected by EFCS and FAC. ADR 3 rejected by EFCS and FAC. F/CTL Alternate law, AP/FD/ATHR & characteristic speeds not available

The two messages Spoiler Elevator Computer 2 (SEC) OR BUS2 from ADR1 and SEC2 OR BUS2 from ADR2 recorded in the PFR showed that SEC2, which compares only CAS1 and CAS2, rejected its two ADR (1 and 2) at that time.

At 07:51:06 UTC, FAC1 recovered its ADR sources (FAC1F = 0). FAC2 was still rejecting any ADR sources (FAC2F = 1). CAS1 (Capt.) was 263kt (on Capt. PFD). CAS2 (FO) was 253kt and CAS3 (FO) was 257kts (on F/O PFD).

h) Manual FAC1 reset

The manual reset (visible in the PFR through the message AFS, FAC1/Push button switch and the transient ECAM warning "AUTO FLT RUD TRIM1 FAULT" enabled.

FAC1 to unlatch the ADR rejection. As the two by two comparisons were within the 10kts threshold, FAC1 recovered the three ADR. The following functions were therefore available again: FD1 - A/THR



- Rudder Travel Limit in FAC1. The ECAM warning AUTO FLT RUD TRV LIM SYS was then replaced by AUTO FLT RUD TRV LIM 2.

Systems status - Pitot 2 heating issue. ADR 1 rejected by EFCS and FAC2 –normal for FAC1. ADR 2 rejected by EFCS and FAC2. Normal for FAC1. ADR 3 rejected by EFCS and FAC2. Normal for FAC1.

F/CTL Alternate law, FD/ATHR & characteristic speeds available, AP was not available (AP is available only if both FACs consider at least two ADRs valid)

From 07:52:38 UTC, aircraft started its descent from FL360.

At 08:00:42 UTC, aircraft was crossing 23,200ft in descent, CAS2 (FO) reached CAS1 (Capt.). CAS1 (Capt) = CAS2 (FO) = 261kts whereas CAS3 (FO) = 256kts.

From 08:01:45 UTC, aircraft was crossing 21,700ft in descent. CAS1 (Capt) was recorded at 255kts. CAS2 (FO) recorded at 254kts started to decrease down to become invalid 5 seconds later. From 08:03:56 UTC, aircraft was crossing 18,400ft in descent. CAS2 (FO) became valid again. CAS2 (FO) was recorded at 114kts whereas CAS1 (Capt) was recorded at 252kts and CAS3 (FO) were recorded at 245kts. CAS2 (FO) was recorded with erratic varying values different from CAS1 (Capt) and CAS3 (FO).

i) CAS2 invalidity, followed by valid but erratic values

CAS2 was recorded decreasing, before becoming invalid (because of a too low measured value). As per the provided weather chart, the a/c was in cloudy weather conditions. The loss of CAS2 during this period was therefore probably due FO Pitot probe heating issue in this cloudy weather conditions. Ice formation is expected to be most severe during descent.

This invalidity was seen by AFS and EFCS, which triggered the fault messages AFS: ADIRU2 and ADR2. When the SSM became valid again, the CAS2 took time to reach the two other CAS. ADR2 was then very likely rejected by comparison by FAC at that time.

Systems status - Pitot 2 heating issue. ADR 1 rejected by EFCS and FAC2. Normal for FAC1.

ADR 2 rejected by EFCS and FAC/FMGC. ADR 3 rejected by EFCS and FAC2. Normal for FAC1.

➤ F/CTL Alternate law, FD/ATHR & characteristic speeds available, AP not available,

At 08:04:16 UTC, A/C was crossing 17,900ft in descent. An unsuccessful AP1 engagement attempt was recorded.

j) Unsuccessful AP engagement attempt

In spite of FAC1 reset, the AP was still unavailable. AP is available only if both FACs consider at least two ADRs valid. ADRs rejection was still latched within FAC2. The unsuccessful AP engagement attempt was associated with the ECAM warning “AUTO FLT AP OFF” and with the fault message AFS: FAC2 (AP engagement not authorized by FAC2).

Systems status - Pitot 2 heating issue. ADR 1 rejected by EFCS and FAC2. Normal for FAC1.

ADR 2 rejected by EFCS and FAC. ADR 3 rejected by EFCS and FAC2. Normal for FAC1.

F/CTL Alternate law, FD/ATHR & characteristic speeds were available, AP not available,

At 08:04:30 UTC, crossing 17,500ft, CAS2 (FO) became consistent with other CAS values. CAS1 (Capt.) was 248kts, CAS2FO was 245kts and CAS3 (FO) was 240kts.



At 08:16:48 UTC, crossing 1750ft RA, FAC1 rejected all ADR sources (FAC1F = 1). CAS were recorded as CAS1 (Capt.) = CAS2 (FO) = 151kts and CAS3 (FO) = 140kts.

k) New multiple ADR rejection by AFS

CAS3 deviated from the two other CAS, leading to all ADRs rejection within both FACs. Both Rudder Travel Limit functions were lost (AUTO FLT RUD TRV LIM SYS). The wind shear detection function (available when slats/flaps out) was lost, associated with the ECAM warning AUTO FLT REAC W/S DET FAULT.

Systems status - Pitot 2 heating issue. ADR 1 rejected by EFCS and FAC. ADR 2 rejected by EFCS and FAC. ADR 3 rejected by EFCS and FAC. F/CTL Alternate law, AP/FD/ATHR & characteristic speeds.

At 08:18:03 UTC, A/C was crossing 1100ft RA (1250ft QNH), landing gears were selected down. Six seconds later, F/CTL reverted to direct law.

l) Direct Law

The reversion to direct law at landing gear extension is expected in case of reversion to alternate law in flight. As per FCOM, if no AP engaged: WHEN L/G DOWN: DIRECT LAW. The a/c was with SLAT/FLAP in Configuration 3 and landed uneventfully at 08:19:38 UTC.

4. Conclusion

4.1 Findings

4.1.1 Aircraft

- a) The aircraft had a valid certificate of airworthiness and a valid certificate of Registration
- b) There were previous defects reported on ADR 3, on the same aircraft during the month of Nov 2020.
- c) This fault is categorized as a Class 2 failure. Upon reporting the same defect from 21st Nov 2020 in several flights an ADD was raised on 24th Nov 2020, by the Maintenance Personnel and it was cleared after two days.
- d) Subsequent to the first incident, an ADD was raised on the same issue on 28th Nov 2020 and it was cleared after the incident, on 3rd Dec 2020 at VCBI.
- e) During the Flight, UL 189 had encountered “ANTI ICE F/O PITOT” warning on ECAM.
- f) The flight UL 190 was dispatched under 2 MEL items and an ADD was raised.

4.1.2 Flight crew

- a) Flight crew had valid licences and were qualified for the flight in accordance with existing regulations.
- b) The flight crew did not switch off the ADR 2 in cloudy weather conditions as required by MEL Operational Procedure, ref. 30-31-01B, which caused ADR2 to continuously provide EFCS and AFS with erroneous CAS.
- c) The Flight crew had failed to detect the speed discrepancy at 100 kts as per Airbus FCOM SOP which requires flight crew to crosscheck and confirm the speed indicated on both PFDs at 100kts during takeoff roll.



4.1.3 Maintenance

- a) The fault in PFR, which was under Class 2 was repeated on several flights prior to incident flight and the Company maintenance personnel had raised ADDs in few instances. Despite of raising ADDs, the maintenance personnel had failed to identify the cause of the fault and rectify without raising further ADDs.
- b) The Operators FDA software does not capture sufficient parameters as required by CAASL SLCAP 4220.
- c) The AMM task referenced in the MMEL enables the detection of anti-ice system faults on other probes as well as a failure within one of the ADR computers. Nevertheless, the task does not allow the detection of a de-calibrated ADM or of a contamination of pneumatic lines.

4.2 Probable cause(s)

Based on the shop reports of the components sent for analysis, it can be concluded that the root causes of this incident were, due to loss of redundancy of the Air Data Reference System, due to an in-service failure of the First Officer's Pitot probe heater and with a combination of faulty standby Air Data Module (ADM 3).

The Pitot probe heating failure happened on approach to VGHS, this failure affected the CAS 2 reading when in icing condition. Therefore due to the unreliability of the 2 Air speeds systems, which resulted in the aircraft initially reverting to F/CTL Alternate Law, and the subsequent loss of AP and ATHR.

5. Safety Measures

Safety measures taken following the incident:

Airbus has launched the improvement of AMM tasks called by the MMEL items linked to Ice Probe Detection.

The modification of the task will consist in adding a PFR check, in case of messages linked to air data issues for the other two ADR channels, triggered by user systems as AFS or EFCS, the AMM task will not be passed and the dispatch with any defective probe heater will be forbidden.

As user systems like EFCS and AFS detects discrepancies between ADR values, the PFR check will allow the detection of existing issues at ADM or pneumatic lines levels. Target date is first quarter of 2022.

6. Safety Recommendations

6.1 Airline

- a) The Airline shall ensure to take maintenance action or raise an ADD whenever maintenance status message is triggered.
- b) The Airline shall ensure the flight crew adhere to the recommended Operational Procedures in MEL ref. 30-31-01B, by switching off the ADR 2 in icing conditions.



- c) The Airline shall reinforce the speed crosscheck at 100 kts as per Airbus Takeoff Standard Operating Procedures.
- d) The Airline shall update the FDA software to satisfy the minimum requirement as stipulated in SLCAP 4220.
- e) The Airline shall include these events of failure in the future evidence based training scenarios of the A320 and A330 if possible.

Aircraft Accident Investigation Board (AAIB) appointed by the Authority

Mr. A.M. Ariyasena

Chief Investigator for this investigation

Capt. N A Keil

Member of the AAIB appointed for this investigation